Department of Horticulture
Mimeograph Report No. 362

February 1970

RESEARCH PROGRESS REPORT

FRUIT AND VEGETABLE PROCESSING AND TECHNOLOGY DIVISION

DEPARTMENT OF HORTICULTURE
2001 Fyffe Court
Columbus, Ohio

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER
Wooster, Ohio
-THE OHIO STATE UNIVERSITY
in cooperation with
OHIO COOPERATIVE EXTENSION SERVICE

TABLE OF CONTENTS

MECHANICAL HARVESTING AND BULK HANDLING EVALUATION OF TOMATO CULTIVARS FOR PROCESSING

by

W. A. Gould, W. T. Huddle, Jonnie Budke, and Louise Howiler*

The 1969 processing tomato project included 8 cultivars of tomatoes which were grown in replicated plots under acceptable commercial practices at the Ohio Agricultural Research and Development Center - Northwestern Branch, Hoytville, Ohio. Each cultivar was machine harvested (with FMC Western Model) and bulk handled in 400 pound lots, either dry, in water, or in water containing 500 ppm chlorine dioxide. Following harvest the tomatoes were transported by truck (approximately 100 miles to The Ohio State University, Columbus, Ohio for processing. All lots were processed after 12 and 24 hours hold after harvest.

QUALITY EVALUATION

1. Percent total acid as citric. The sample (raw or canned) used for pH determination was directly titrated using 0.1 Normal Sodium Hydroxide solution to a pH of 8.1. Calculations using the following equation were made:

$$\% \text{ acid} = \frac{(\text{No. of ml. of } 0.1 \text{ N NaOH})\ (.0064)}{10 \text{ ml. sample}} \times 100$$

2. pH. The pH was determined by the glass electrode method (Beckman Zeromatic pH meter) using 10 ml. of tomato juice (raw or canned) diluted with 90 ml. of distilled water.

3. Juice Color. Agtron F samples of raw or canned tomato juice were presented to the Agtron F instrument in a standard plastic sample cup. The instrument was standardized, using a black plastic plate (Monsanto Lustrex 11250) as 70. Readings were taken directly.

4. Percent soluble solids. An Abbe 3L refractometer was used for direct determinations of percent soluble solids

*Assistance of W. N. Brown, Vegetable Crop Division; Clair Zimmerman, James Trotter and staff, Northwestern Branch OARDC; and the Processing and Technology Students -- Marshall Bash, Richard Dafler, Loren Lucas, John Mount and Teresa P. Umana is gratefully acknowledged.

on raw or canned juice. The instrument was standardized with distilled water and all readings converted to 20°C. No correction is made for salt.

5. Grades of Canned Tomatoes. The grade was determined in accordance with the U.S. Standards for Grades of Canned Tomatoes.

6. Grades of Canned Tomato Juice. The grade was determined in accordance with the U.S. Standards of Grades of Canned Tomato Juice.

7. Viscosity. The viscosity was measured using the GOSUC efflux tube instrument containing a 5/64" opening and standardized at 32 seconds at 25°C. with water. The rate of flow from the instrument was measured with a stop watch and the readings recorded directly.

8. Raw tomato cut surface color. A random sample of 20 raw tomatoes were cut in half and color measured on the Agtron E instrument. The "E" values reported are an average for the 20 tomatoes.

9. Vitamin C. Ten ml aliquots of tomato juice were diluted with 90 ml. of 1% meta phosphoric acid and filtered. A 10 ml. aliquot of the filtrate was titrated with 0.2% 2, 6-dichlorophenolindophenol indicator solution. Milligrams of vitamin C were determined by the following formula:

$$\text{Dye factor} \times \text{ml. of dye} \times 100 = \frac{\text{mgm. Vit. C}}{\text{100 gms.}}$$

PREPARATION AND PROCESSING

All tomatoes were prepared by washing, lye peeling (18% caustic soda and Faspeel at 200°F. for 20 to 30 seconds), and processed as whole tomatoes or washed, chopped, hot broken at 190°F, extracted and plate pasteurized 250° for 0.7 seconds, filtered, closed and cooled in the OSU Pilot Plant.

Each lot of whole tomatoes was filled to 10.5 - 11.0 ounces in No. 303 plain tin cans with 30 grain salt (21 grains Sodium and 9 grains Calcium Chlorite).

RESULTS

The results are presented in Tables I and II.

SUMMARY

Heinz 1548	Fruits are round, small to medium size (6/303) and must be cored. Canned product of good quality (B grade) due to color. pH of canned product is high, but total acidity good.
Heinz 14451	Fruits are small to medium size (6/303), pear to oblong shape, and small core. Canned product has high quality (A-B grade). Product has excellent wholeness and drained weight. pH and total acidity in safe range.
Chico Grande III	Fruits are pear shaped, small to medium size (5/303), with small core and relatively low total acid and Vitamin C content. Canned product high quality (A-B grade). Does not have high drained weight and color, but excellent wholeness.
Harvester	Fruits are pear shaped, small (7/303), small core, high pH and low total acid content. Canned product of high quality, generally all A grade. Product should be acidified. Raw product has high soluble solids content.
MD87a	Fruits are round, small (5-6/303), and have small cores. Canned product of average quality (B grade) primarily due to color scores. Product has low total acid and high pH -- should be acidified.
LaBonita	Very small fruit (7/303), round, green shoulders, small core, and very soft. Average canned product quality due to color and drained weight. Good pH and total acidity.
Bouncer	Large fruit (4/303), oblong, some green shoulders, and some cracking on mature fruits. Very high pH and extremely low total acid content. Excellent wholeness attribute scores on canned product, however, fruits must be cored. Product must be acidified.
Libby 1626	Fruits are small (6/303) with very small core. Canned product of average quality (B grade). Product has high total acidity and good pH. Not highly recommended for peeling, but excellent for juice.

TABLE I. 1969 RAW PRODUCT TOMATO CULTIVARS EVALUATION - OBJECTIVE QUALITY AND CHEMICAL ANALYSIS

Cultivar	Treatment	Agtron F	% Soluble Solids	% Citric	pH	Vitamin C
Heinz 1548	Tank - water	70	5.0	.448	4.35	21.12
	Tank - solution	100+	5.1	.512	4.3	22.37
	Tank - dry	100+	5.5	.448	4.3	14.91
	Box - dry sorted (mach)	64	5.85	.410	4.33	19.88
	Box - dry unsorted (proc)	67	5.8	.471	4.43	23.61
	$\bar{x}$	88	5.4	.457	4.3	20.37
Heinz 14451	Tank - water	37	6.3	.422	4.5	16.98
	Tank - solution	38	5.8	.403	4.5	19.40
	Tank - dry	36	5.8	.422	4.8	18.19
	Box - dry sorted (mach)	25	6.2	.429	4.4	20.61
	Box - dry unsorted (proc)	24	5.2	.454	4.5	24.25
	$\bar{x}$	32	5.8	.426	4.5	19.87
Chico Grande III	Tank - water	37	5.5	.371	4.5	17.40
	Tank - solution	54	5.6	.390	4.75	17.40
	Tank - dry	46	5.9	.378	4.6	21.12
	Box - dry sorted (mach)	47	5.55	.376	4.5	17.40
	$\bar{x}$	46	5.6	.378	4.6	18.63
Harvester	Tank - water	25	6.0	.358	4.6	19.40
	Tank - solution	37	6.2	.339	4.6	19.40
	Tank - dry	37	5.6	.339	4.6	19.40
	Box - dry sorted (mach)	32	6.6	.384	4.6	24.25
	Box - dry unsorted (proc)	32	6.4	.448	4.4	19.40
	$\bar{x}$	32	6.3	.373	4.6	20.37

TABLE I. (Continued)

Cultivar	Treatment		Agtron F	% Soluble Solids	% Citric	pH	Vitamin C
MD87a	Tank - water		27	6.2	.416	4.5	19.40
	Tank - solution		28	6.2	.410	4.6	19.40
	Tank - dry		34	6.5	.390	4.4	24.25
	Box - dry sorted (mach)		41	5.4	.365	4.5	19.40
	Box - dry unsorted (proc)		23	6.4	.390	4.5	19.40
		$\bar{x}$	30	6.1	.394	4.5	20.37
LaBonita	Tank - water		78	5.0	.384	4.5	19.88
	Tank - solution		76	5.6	.378	4.35	24.85
	Tank - dry		77	5.3	.397	4.45	17.40
	Box - dry sorted (mach)		75	5.2	.432	4.3	17.40
	Box - dry unsorted (proc)		60.5	5.5	.464	4.33	21.13
		$\bar{x}$	73	5.3	.411	4.4	20.13
Bouncer	Tank - water		32	5.2	.301	4.6	19.40
	Tank - solution		45	5.4	.288	4.6	19.40
	Tank - dry		35	5.2	.320	4.6	14.55
	Box - dry sorted (mach)		36	5.5	.288	4.5	19.40
	Box - dry unsorted (proc)		26	5.2	.326	4.5	14.55
		$\bar{x}$	34	5.3	.304	4.6	17.46

TABLE II. 1969 TOMATO CULTIVAR EVALUATION GRADE AND OBJECTIVE EVALUATION OF WHOLE TOMATOES

Cultivars	Hdlg.		Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
Heinz 1548	Water		12	4.4	.484	17.7	17	26.3	30	91.0	A
			24	4.6	.399	15.3	15.3	23.7	28.3	82.6	B
		$\bar{x}$		4.5	.442	16.5	16.2	25.0	29.2	86.8	B
	Solution		12	4.27	.446	17	18	25.7*	30	90.7	B
			24	4.57	.439	15	17	23.3	28.3	83.6	B
		$\bar{x}$		4.42	.443	16	17.5	24.5	29.2	87.2	B
	Dry		12	4.57	.437	17.7	18	25.7	28	89.4	B
			24	4.5	.506	16.7	19	24	30	89.7	B
		$\bar{x}$		4.54	.472	17.2	18.5	24.9	29	89.6	B
	Dry Box		12	4.47	.433	19.3	18	27.3	26.7	91.3	A
			24	4.5	.429	19.7	17	23*	28.7	88.4	C
		$\bar{x}$		4.49	.431	19.5	17.5	25.2	27.7	89.9	B
		$\bar{x}$	12	4.43	.450	17.9	17.8	26.3	28.7	90.6	A
		$\bar{x}$	24	4.54	.443	16.7	17.1	23.5	28.8	86.1	B
		$\bar{\bar{x}}$		4.49	.447	17.3	17.4	24.9	28.8	88.3	B

*limiting rule

TABLE II (Continued)

Cultivars	Hdlg.		Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
Heinz 14451	Water		12	4.5	.401	16	20	25.3	28	89.3	B
			24	4.5	.358	18.7	19	25*	29	91.7	B
		$\bar{x}$		4.5	.380	17.4	19.5	25.2*	28.5	90.5	B
	Solution		12	4.5	.401	17	20	25*	29	91.0	B
			24	4.5	.363	18.3	19	27.7	28	93.0	A
		$\bar{x}$		4.5	.382	17.7	19.5	26.4	28.5	92.0	A
	Dry		12	4.3	.380	19	19.3	24.3*	28	90.6	B
			24	4.4	.333	19.7	19.7	28.7	29	97.1	A
		$\bar{x}$		4.35	.357	19.4	19.5	26.5	28.5	93.9	A
	Dry Box		12	4.3	.391	18.7	20	25*	29	92.7	B
			24	4.5	.384	17.7	19.7	27.3	29	93.7	A
		$\bar{x}$		4.4	.388	18.2	19.9	26.2	29.0	93.2	A
		$\bar{x}$	12	4.4	.393	17.7	19.8	24.9*	28.5	90.9	B
		$\bar{x}$	24	4.48	.360	18.6	19.4	27.2	28.8	93.9	A
		$\bar{\bar{x}}$		4.44	.376	18.1	19.6	26.0*	28.6	92.4	B

*limiting rule

TABLE II (Continued)

Cultivars	Hdlg.		Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
Chico Grande III	Water		12	4.4	.348	16	20	27.7	29	92.7	A
			24	4.3	.383	18	18	24	29	89.0	B
		$\bar{x}$		4.35	.366	17	19	25.9*	29.0	90.9	B
	Solution		12	4.5	.314	16.3	20	27	27	90.3	A
			24	4.5	.377	18	17	24	27	86	B
		$\bar{x}$		4.5	.346	17.2	18.5	25.5	27	88.2	B
	Dry		12	4.4	.301	16.7	20	26.3	28	91	A
			24	4.3	.365	14.7*	20	26.7	29	90.4	B
		$\bar{x}$		4.35	.333	15.7	20	26.5	28.5	90.7	A
	Dry Box		12	4.57	.297	19.7	20	24*	28	91.7	B
			24	4.3	.348	17.3	20	24.7	27.3	89.3	B
		$\bar{x}$		4.44	.323	18.5	20	24.4*	27.7	90.5	B
		$\bar{x}$	12	4.47	.315	17.2	20	26.3	28	91.4	A
		$\bar{x}$	24	4.35	.368	17.0	18.8	24.9	28.1	88.7	B
		$\bar{x}$		4.41	.354	17.1	19.4	25.6*	28.0	90.1	A

*limiting rule

TABLE II (Continued)

Cultivars	Hdlg.		Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
Harvester	Water		12	4.6	.358	18	19.3	26.3	29	92.6	A
			24	4.5	.329	19.3	19.3	26.3	29	93.9	A
		$\bar{x}$		4.55	.344	18.7	19.3	26.3	29	93.3	A
	Solution		12	4.6	.347	18.3	20	24.7*	27.7	90.7	B
			24	4.6	.378	17	19.3	25.7*	28.3	90.3	B
		$\bar{x}$		4.6	.363	17.7	19.7	25.2*	28.0	90.5	B
	Dry		12	4.4	.363	18.7	20	26*	28	92.7	B
			24	4.5	.326	17.3	19	27	29	92.3	A
		$\bar{x}$		4.45	.345	18.0	19.5	26.5	28.5	92.5	A
	Dry Box		12	4.5	.345	17.7	20	26.7	29	93.4	A
			24	--	--	--	--	--	--	--	--
		$\bar{x}$		4.5	.345	17.7	20	26.7	29	93.4	A
		$\bar{x}$	12	4.53	.353	18.2	19.8	25.9*	28.4	92.4	B
		$\bar{x}$	24	4.53	.344	17.9	19.2	26.3	28.8	92.2	A
		$\bar{\bar{x}}$		4.53	.349	18	19.6	26.1	28.6	92.3	A

*limiting rule

TABLE II (Continued)

Cultivars	Hdlg.		Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
MD87a	Water		12	4.5	.356	17	18.7	25	28.3	89	B
			24	4.6	.314	18	19	26.7	28	91.7	A
		$\bar{x}$		4.55	.335	17.5	18.9	25.9*	28.2	90.4	B
	Solution		12	4.6	.339	19	19.3	25*	27	90.3	B
			24	4.5	.343	17.7	20	26.7	28	92.4	A
		$\bar{x}$		4.55	.341	18.4	19.7	25.9*	27.5	91.4	B
	Dry		12	4.4	.333	17	19	26*	28	90	B
			24	4.6	.331	16.3	17	26	26	85.3	B
		$\bar{x}$		4.5	.332	16.7	18	26	27	87.7	B
	Dry Box		12	4.5	.373	17.3	19.3	26.3	28	90.9	A
			24	4.4	.352	16.7	18.7	25.3	29	89.7	B
		$\bar{x}$		4.45	.363	17	18	25.8	28.5	90.3	B
		$\bar{x}$	12	4.5	.350	17.6	19.1	25.6*	27.8	90.1	B
		$\bar{x}$	24	4.53	.335	17.2	18.7	26.2	27.8	89.8	B
		$\bar{\bar{x}}$		4.51	.343	17.4	18.9	25.9	27.8	89.9	B

*limiting rule

TABLE II (Continued)

Cultivars	Hdlg.		Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
LaBonita	Water		12	4.4	.476	15.3	19	26.3	29	89.6	B
			24	4.2	.440	16.7	18.3	24.3	29	88.3	B
		$\bar{x}$		4.3	.458	16.0	18.7	25.3	29	89	B
	Solution		12	--	--	--	--	--	--	--	--
			24	4.3	.407	17.5	19	24.7	28.5	89.7	B
		$\bar{x}$		4.3	.407	17.5	19	24.7	28.5	89.7	B
	Dry		12	4.3	.471	18.5	19	24.5	27	89	B
			24	4.32	.425	14.3	18.7	25	28.3	86.3	B
		$\bar{x}$		4.31	.448	16.4	18.9	24.8	27.7	87.7	B
	Dry Box		12	4.25	.463	17	20	24.7	28	89.7	B
			24	4.7	.401	18.7	19	27.3	28	93	A
		$\bar{x}$		4.48	.432	17.9	19.5	26*	28	91.4	B
		$\bar{x}$	12	4.32	.470	16.9	19.3	25.2	28	89.4	B
		$\bar{x}$	24	4.38	.418	16.8	18.8	25.3	28.5	89.3	B
		$\bar{\bar{x}}$		4.35	.440	16.9	19.0	25.3	28.3	89.4	B

*limiting rule

TABLE II (Continued)

Cultivars	Hdlg.		Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
Bouncer	Water		12	4.7	.276	16.7	20	25.7*	30	92.4	B
			24	4.6	.275	15	19.3	26*	30	90.3	B
		$\bar{x}$		4.65	.276	15.9	19.7	25.9*	30	91.4	B
	Solution		12	4.7	.254	19.7	20	27.3	30	97.0	A
			24	--	--	--	--	--	--	--	--
		$\bar{x}$		4.7	.254	19.7	20	27.3	30	97.0	A
	Dry		12	4.6	.283	18.7	18	24.7*	30	91.4	B
			24	4.6	.258	15.7	20	26.3	30	92.0	A
		$\bar{x}$		4.6	.271	17.2	19	25.5*	30	91.7	B
	Dry Box		12	4.7	.217	18	18.7	27.7	30	94.4	A
			24	4.2	.311	17.3	19	26*	30	92.3	B
		$\bar{x}$		4.45	.264	17.7	18.9	26.9	30	93.4	A
		$\bar{x}$	12	4.68	.258	18.3	19.2	26.4	30	93.8	A
		$\bar{x}$	24	4.47	.281	16.0	19.4	26.1	30	91.5	A
		$\bar{x}$		4.59	.268	17.3	19.3	26.2	30	92.9	A

*limiting rule

TABLE II (Continued)

Cultivars	Hdlg.		Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
Libby 1626	Water		12	4.4	.435	16.7	17.3	26.7	27	87.7	B
			24	4.2	.469	15.3	17.7	26.7	27	86.7	B
		$\bar{x}$		4.3	.452	16.0	17.5	26.7	27.0	87.2	B
	Solution		12	4.4	.452	14.3	19.3	26.7	27	87.3	B
			24	4.5	.497	13.7	19	27	28	84.7	B
		$\bar{x}$		4.45	.475	14.0	19.2	26.9	27.5	86.0	B
	Dry		12	4.2	.459	16	18	28	27	89	B
			24	4.3	.452	13.7	18	25.3	27	84	B
		$\bar{x}$		4.25	.456	14.9	18	26.7	27	86.5	B
	Dry Box		12	4.2	.425	15.7	17.3	26.3	27.3	86.6	B
			24	4.2	.391	14.7	17.3	25	27	84	B
		$\bar{x}$		4.2	.408	15.2	17.3	25.7	27.2	85.3	B
		$\bar{x}$	12	4.3	.443	15.7	18	26.9	27.1	87.7	B
		$\bar{x}$	24	4.3	.452	14.4	18	26	27.3	84.9	B
		$\bar{x}$		4.3	.448	15.0	18	26.5	27.2	86.3	B

*limiting rule

TABLE III. 1969 TOMATO JUICE EVALUATION - OBJECTIVE QUALITY AND CHEMICAL ANALYSIS HELD 24 HOURS AFTER HARVEST -- FIELD RUN (AVERAGE VALUES)

Cultivar	Vis-cosity (sec)	Agtron F	Vit. C mg AA	% S.S.	pH	T.A.	Color (30)	Consist-ency (15)	Defects (15)	Flavor (40)	Total Score	Grade
Chico Grande III	50	29	20.80	6.8	4.5	.384	30	15	15	40	100	A
Heinz 1548	45	42.5	19.50	5.8	4.5	.496	26	13	15	28*	82	C
LaBonita	46.5	42	18.20	6.0	4.48	.500	28	15	15	30*	88	C
Bouncer	40	29	20.80	5.5	4.5	.416	26	12	15	30*	83	C
Heinz 14451	57	24.5	20.80	6.2	4.5	.423	30	15	15	38	98	A
Libby 1626	46	34.5	18.83	6.1	4.5	.413	30	15	15	38	98	A
Harvester	43.5	23	20.80	6.5	4.6	.387	30	15	12	38	98	A
MD87a	48	24.5	20.80	6.5	4.7	.276	30	15	15	36	96	A

*limiting rule

VARIABLES AFFECTING THE EFFICIENCIES OF PEELING TOMATOES WITH CAUSTIC SODA (LYE)

by

Loren L. Lucas and Wilbur A. Gould

The chemical peeling of fruits and vegetables has been used in the food processing industry for many years. Only in recent years, however, has it been successfully applied to tomatoes. This study was undertaken to determine some of the effects of caustic solution temperatures and concentration upon peel loss, peel removal time and the finished product quality of canned tomatoes.

The tomatoes utilized in this work were grown at the Northwestern Branch of the Ohio Agricultural Research and Development Center, Hoytville. The tomato cultivars used were Chico Grande III, Harvester, LaBonita, Experimental 68624, Experimental 627, Heinz 14451, Bouncer, and Heinz 1548.

After harvest the tomatoes were shipped to the Horticulture Processing Pilot Plant at The Ohio State University. The tomatoes were stored 12 to 48 hours prior to processing.

Each cultivar used in this study was washed and peeled by the conventional steam scald method (45 seconds live steam) and in lye at 16, 18, and 20 percent solutions at temperatures of 190, 200, and 210°F. 0.3 percent Faspeel was used in part of the studies and 0.3 percent Tergitol in other studies. Following peeling, the peel loss was calculated, tomatoes were packed in 303 plain tin containers at a fill rate of 13 to 13½ ounces, with a 30 g salt tablet (21 grains NaCl and 9 grains $CaCl_2$) added to each container. The containers were then filled with 190°F. tomato juice. The cans were closed with an American Can Company No. 006 closing machine with a steam flow pressure of 17 pounds. They were then processed for 20 minutes at 220°F., cooled to room temperature and after four months storage were graded and analyzed for quality.

pH, total acidity, and grade according to the quality attributes as set forth in the United States Department of Agriculture standards for grades for canned tomatoes were evaluated on each sample.

Some of the results of this study are presented as follows:

The peel loss involved with caustic peeling was increased 1 to 2 percent for each increase of 10°F. The peel loss was reduced by increasing caustic solution concentration. The use of the wetting agents increased the peel loss percentage of tomatoes

peeled with the lower caustic solution concentration. The caustic submergence time required to remove tomato peel was found to be reduced with increasing caustic solution temperatures and concentrations.

The pH of canned tomatoes was increased as the caustic concentration of the peeling solution increased. The total acidity of steam peeled tomatoes was higher than for the caustic peeled tomatoes. Increasing caustic temperature and concentration did reduce the finished product acidity.

The Absence of Defects scores for canned tomatoes were increased as the caustic temperature was increased. By using the wetting agents Faspeel, this resulted in reduced tomato Absence of Defects scores, however, with the wetting agent Tergitol an increase in the Absence of Defects score was noted.

The Drained Weight scores of canned tomatoes was increased as the caustic peeling solution concentration was increased. The Drained Weight scores of tomatoes was reduced, however, as the caustic solution temperatures was increased. The application of the wetting agent to peeling solution did increase the tomato Drained Weight scores.

The Wholeness score of canned tomatoes was reduced as the fruit was exposed to increasing caustic solution concentration.

TABLE I. EFFECTS OF PEELING TEMPERATURE, CAUSTIC CONCENTRATION WITH AND WITHOUT WETTING AGENTS ON % PEEL LOSS, pH, TOTAL ACID (TA), ABSENCE OF DEFECTS (30 pts), DRAINED WEIGHT (20 pts), AND WHOLENESS (20 pts)
1968

		16% Caustic			18% Caustic			20% Caustic		
Attribute	Peel Temp	No Wet Agent	Tergitol	Faspeel	No Wet Agent	Tergitol	Faspeel	No Wet Agent	Tergitol	Faspeel
% Peel Loss	190°F.	19.5	18.8	22.0	19.2	17.1	18.3	18.1	16.4	--
	200	18.3	21.8	22.6	20.2	22.1	20.3	19.9	19.7	20.3
	210	22.3	23.0	25.7	21.6	23.9	22.7	22.5	22.9	22.0
pH	190	4.55	4.65	4.63	4.49	4.62	4.68	4.66	4.57	--
	200	4.60	4.66	4.59	4.57	4.60	4.61	4.64	4.60	4.65
	210	4.55	4.65	4.58	4.54	4.63	4.64	4.64	4.60	4.64
Total Acid	190	.33	.32	.30	.39	.33	.30	.30	.31	--
	200	.32	.29	.32	.36	.31	.33	.30	.30	.28
	210	.31	.30	.35	.38	.32	.31	.30	.29	.30
Absence of Defects	190	28.0	27.9	27.9	27.6	28.1	27.7	27.2	28.1	--
	200	27.8	27.6	27.1	28.7	28.3	27.8	27.1	28.4	27.6
	210	28.6	28.1	27.6	28.9	28.1	27.5	28.1	28.7	27.8
Drained Weight	190	16.3	17.6	17.8	19.5	18.2	17.6	18.3	18.1	--
	200	16.7	16.6	17.1	18.3	17.6	17.9	18.3	17.5	18.3
	210	16.2	17.4	16.6	18.4	17.0	17.6	17.1	16.3	17.8
Wholeness	190	18.8	18.6	19.1	19.5	19.1	19.2	18.4	18.7	--
	200	18.9	18.9	19.1	18.3	18.6	18.4	18.0	19.2	18.5
	210	18.8	19.0	19.8	18.4	18.7	18.3	18.2	18.6	18.3

TABLE II. EFFECT OF PEEL TEMPERATURE AND CAUSTIC SOLUTION CONCENTRATION WITH FASPEEL ON % PEEL LOSS, pH, TOTAL ACID (TA), ABSENCE OF DEFECTS (30 pts), DRAINED WEIGHT (20 pts) AND WHOLENESS (20 pts)
1969

Attribute	Peel Temperature	18% Caustic		20% Caustic	
		No Acid	Acidified	No Acid	Acidified
% Peel Loss	180 °F.	13.4	--	15.1	--
	190	13.1	--	13.7	--
	200	13.7	--	16.0	--
pH	180	4.45	4.04	4.44	4.04
	190	4.46	3.95	4.43	4.06
	200	4.50	4.09	4.48	4.06
Total Acid	180	.36	.64	.35	.64
	190	.36	.72	.36	.62
	200	.35	.62	.38	.61
Absence of Defects	180	27.7	27.5	27.4	27.3
	190	27.5	27.7	27.8	27.5
	200	27.7	27.2	27.9	27.3
Drained Weight	180	16.7	17.3	17.6	16.5
	190	17.4	17.3	16.7	18.4
	200	17.2	16.0	17.8	17.3
Wholeness	180	18.1	18.0	17.5	17.8
	190	18.2	17.8	18.3	18.4
	200	18.3	18.0	17.8	17.3

EFFECTS OF SEVERAL GENERA OF MOLD ON TOMATOES AND IN MOLD COUNTS

by

Michele M. Constable and Wilbur A. Gould

INTRODUCTION

Mold counting is now a common quality control procedure in processing plants manufacturing tomato products. By counting the mold filaments in small, but thoroughly mixed samples of tomato products, an indication is given of the care taken in processing with regard to using sound tomatoes, efficient trimming, and general cleanliness of plant operation.

Molds were long known to be common contaminants of tomatoes which led to their decomposition and subsequent lowering of quality in canned products. The first description of procedures regarding the principles and methods of mold counting was published in 1911 by Burton J. Howard, chief of the microchemical laboratory of the United States Department of Agriculture Bureau of Chemistry. Howard developed mold counting as an aid in enforcing the Food and Drug Act of 1906, which stated that a food is deemed to be adulterated "if it consists in whole or in part of a filthy, decomposed, or putrid animal or vegetable substance".

Howard's mold counting technique has remained relatively the same with only minor changes since the first publication nearly 60 years ago. With modifications, it is now the official method of analysis of the Association of Official Agricultural Chemists for the determination of molds in tomato products.

Mold counting is concerned only with the presence or absence of mold filaments in particular fields; no attempt is made to determine what type of mold is present. Molds cannot be identified by only a filament as seen under the microscope, so this is a logical limitation.

However, if a person counting mold were familiar with different types of molds, it would be helpful for two basic reasons. First, in knowing the characteristics of different genera of molds and being familiar with their structure, it would be much easier for the counter to recognize mold as it was seen in the tomato products. Second, and more importantly, if the type of mold could be recognized, the source of contamination might be determined. The obvious example is recognizing machinery mold, *Oospora lactis*, as originating from faulty plant sanitation rather than from the raw tomatoes. Further applications are the recognition that some molds, e.g. *Alternaria sp.*, are common

on tomatoes in the field, while others, e.g. Mucor, Aspergillus, and Rhizopus, are usually found following harvest through processing.

The objective of this study was to analyse different genera of mold and their relative effects on tomatoes, as determined by culturing the molds on tomatoes, making mold counts from juice with the use of infected tomatoes and studying the appearance of these mold filaments in the juice.

EXPERIMENTAL PROCEDURES

Cultures of Rhizopus, Mucor, Aspergillus, Penicillium, Oospora lactis, Alternaria, Fusarium and Botrytis were obtained from the cultural room of the Department of Molecular and Cellular Biology, Department of Organismic and Developmental Biology, and in the Department of Plant Pathology.

Tomatoes of several cultivars were obtained from the Department of Horticulture greenhouses for use in this study. Prior to inoculation, the stem or calyx was removed and the tomatoes were soaked in a 5% sodium hypochlorite (Clorox) solution for about two minutes.

The tomatoes were slit with a sterile inoculating needle and the mold was inoculated directly into the tomato tissue. Sufficient tomatoes were inoculated so that at least ten mold counts could be made from separate tomatoes inoculated with each type of mold.

Growth of mold on the inoculated tomatoes was recorded, and it was noted that the growth rates of the different genera varied greatly as did the growth of the same mold on different tomatoes.

In most cases, mold counts were made after a week or less of growth, but in some cases as long as three weeks was needed to get a good culture.

Some contamination was evident from the appearance of mold on a different area than where inoculated or the appearance of a mold with obviously different growth characteristics.

After substantial mold growth had appeared on a tomato, the moldy area was trimmed away. This portion was weighed, and tomato juice was added to it in the proportion of 10% moldy tomato to 90% tomato juice. Although this was not a precise ratio, it does represent an attempt to use up to 10% moldy fruit for each study.

The juice then was blended in a Waring blender at low speed for 10 seconds to simulate juice manufacture. The tomato mixture was then deaerated and mold counts were made according to the Howard mold count method.

Photomicrographs of the juice samples were recorded using a Spencer microscope with a built-in attachment for a Kodak Pony camera. The photomicrographs were taken from regularly prepared Howard mold counting slides at a magnification of 100X with Kodacolor X type film. Generally, the light source, an automatic voltage selector, was set at 6.5V, and the shutter speed of the camera was set at 1/10 second in some cases with dark samples a speed of 1/5 second was used.

In general the genera of mold studied showed very different characteristics from each other with respect to growth rate, amount of growth, and effect on the tomato as summarized in Table I. The appearance of the tomatoes was not the same as that of tomatoes infected in the field with these same molds, in that sunken or watery spots or blackening of tissues did not appear to the same extent. Further, there was more aerial growth on these tomatoes than would be found on field tomatoes, but these differences were believed due to the fact that the tomatoes for this study had been artificially inoculated and cultivated under laboratory conditions.

When mold counts were made from juice including the moldy tomatoes, conditions were only slightly different from mold counts of regular processed tomato juice, when mold is present. The major difference was that spores and spore-bearing heads of the mold were often present. While the spore-bearing structures are the main point of identifying the type of mold, they are not generally present in processed juice, because visible mold is usually trimmed or washed away prior to processing.

One other major difference was noted and that is that larger clumps of mold were present in these samples than in commercially processed juice. This was believed due to the fact that the moldy tomatoes in this study were only blended in a blender and consequently the normal break up would not be shown.

A summary of the attributes of genera mold as they appeared under the miscroscope is presented in Table II.

A summary of the percent positive fields for the different lots, for the different genera of molds are shown in Table III.

Only three of the eight molds averaged above the 20 percent positive field. But in at least one of the ten counts three other genera molds were above this limit. The molds which did not grow fast on the tomatoes did not give a high mold count. This was the reason for Oospora lactic showing a low count, not that it is not a potential cause of high mold count in tomato products. The range in average counts from 1.2% to 54.2% showed a large variation in the positive field, even though the same percent of moldy tomato was incorporated. This further indicated

a difference in the ability of the molds to grow on tomatoes and a difference in ease of blending the molds throughout the juice.

The results of this investigation differ somewhat from those found for tomatoes grown under field conditions. Under laboratory conditions Alternaria tenuis showed a moderate gray-green growth as opposed to the black or brown decayed areas with flattened or sunken surfaces reported by McCulloch. He further stated that olive-green or black spore masses may grow over the surfaces, but only with humid conditions with a dark-gray surface mold develop.

Another example was the case of Fusarium, which was found difficult to culture in the laboratory. McCulloch reported that many species of Fusarium cause rot in the field which is characterized by water soaking, softening, and wrinkling in lesions on the tomato. Fusarium rot is said to progress rapidly and completely destroy the tomato within a few days.

This investigation showed Botrytis to be a fast growing mold which produced long gray filaments. In the field, Botrytis first produces water-soaked lesions, and under humid conditions or development of cracks in the lesions, gray filaments are produced.

These differences were believed to be the results of culturing the molds under different conditions than prevalent in the field, as well as being due to factors such as the age and substrate of the culture.

Certain molds, e.g. Penicillium and Rhizopus, showed relatively the same effects in this study as commonly found on tomatoes. Rhizopus typically caused a soft watery rot which caused the tomato to collapse with handling. Penicillium is prevalent as blue-green spots of mold on the media on which it is common. These results obtained during this investigation agree with those found in literature.

Oospora lactis was a unique mold to study in that it did not grow readily on tomatoes unless they were contaminated with other molds. A plausible explanation is that the contaminating molds were species of Rhizopus and Mucor which produce lactic acid, thus giving the O. lactis a course of lactic acid which is necessary for its metabolism.

Since certain molds, e.g. Mucor, Aspergillus, and Rhizopus, enter the tomato both in the field and from the boxes after harvesting, it might be a practical idea to clean the lug boxes periodically. This study showed that these molds grew rapidly and profusely, which was an indication that tomatoes should not remain in the boxes long after harvesting if these molds were suspected to be present.

TOMATO JUICE WITH THE MOLDS PRESENT

Again the results in this study were contingent upon the specific cultures used and the defined laboratory conditions, but in the tomato juice the results were probably more similar to field conditions than in the appearance of molds on the whole tomatoes. Since Fusarium and Penicillium showed a distinct tendency to remain in clumps during blending and showed up on the mold counting slides grouped together, these molds might not pass through the machinery during processing, and thus not show up in the finished product.

As an aid in identifying the types of mold by their appearance under the microscope, it was found that all the molds studied had granulation and quite a lot of branching, so these common mold characteristics would be useless in determining specific types of mold.

Septation was present in all of the molds except Mucor and Rhizopus, which were also the thickest molds. These molds sometimes had rounded growing ends, so on the basis of these characteristics they could be tentatively identified.

As was noted in Table II, the size of the molds was a significant identifying characteristic in that there were definite thick molds, some which were noticeably fine, and some which were of medium thickness. The sizes of the molds can be compared from photomicrographs, but this factor alone was only a clue toward possible identity.

Pointed tips were present in several of the molds, however, this factor alone could not identify a genus.

O. lactis had characteristic branching when it grew profusely, and could tentatively be identified by its tapered, feathery branching. It would be of value to be able to identify O. lactis since it is known to originate from poor sanitation in the processing plants. The fact that O. lactis did not grow well when inoculated directly on tomatoes was determined during this investigation, adding to the evidence that when O. lactis is present in tomato products, its source is somewhere other than the tomatoes from the field.

As determined through this study and from literature, molds cannot be identified according to genus or species as they appear comminuted tomato products. In fact, even if the spore-bearing structures were present, a precise identification could not be made.

However, with certain characteristics noted for particular types of mold, as was determined for eight genera of molds in

this study, molds can sometimes be tentatively identified and more often distinguished from each other to a certain extent. For example, as found in this investigation, Mucor and Rhizopus can be recognized from the others, O. lactis can be recognized if its feathered branching is present, and Penicillium and Fusarium could be recognized as finer molds with a tendency to clump. Alternaria tenuis, Aspergillus, and Botrytis could not be identified from each other with the data presented in this thesis.

This type of information is valuable in determining the probably source of the mold. If O. lactis were present, the plant machinery would be suspected as the source of contamination. If Penicillium, Mucor, Rhizopus, or Aspergillus were recognized, the mold might be traced to post-harvest contamination. By knowing the probable source of contamination, measures could be taken to eliminate or reduce the contaminant.

MOLD COUNTS FROM THE JUICE

In this study it was determined that mold counts with 10% moldy tomato incorporated into 90% clean juice had a range of 1.2% positive fields to 54.2% positive fields depending on the genus of mold. There were several possible reasons for some of these variations.

REFERENCE

Constable, Michele M., "Effect of Several Genera of Molds on Tomatoes and in Mold Counts." Unpublished M.Sc. Thesis, The Ohio State University (1969).

McCulloch, L. P., H. T. Cook, and W. R. Wright, "Market Diseases of Tomatoes, Peppers, and Eggplants." U.S.D.A. Agriculture Handbook No. 28 (February 1968).

TABLE I. SUMMARY OF CHARACTERISTICS OF THE MOLD ON THE TOMATOES

Genus	Relative Amt. of Growth	Rate of Growth	Color of Mold Colony	Appearance	Effect on Tomato
Alternaria tenuis	moderate	moderate	white to gray-green	slightly aerial, fluffy	sunken spots around growth
Aspergillus	profuse	rapid	bright medium green to yellow	slightly aerial compact masses	sunken spots around growth
Botrytis	very profuse	rapid	light gray	light feathery aerial	sunken spots around growth
Fusarium	little	slow	white, light gray, green	flat	little
Mucor	very profuse	rapid	white	feathery much aerial	watery
Oospora lactis	little	slow	white	slimy mass	watery
Penicillium	little	slow	blue-green	flat mass	little
Rhizopus	moderate	moderate	white	aerial	watery

TABLE II. SUMMARY OF CHARACTERISTICS OF THE MOLDS AS THEY APPEARED IN TOMATO JUICE

Genus	Size	Clumping	Septation	Granulation	Branching	Parallel Walls
Alternaria tenuis	medium thick	slight	septate	present	much	present
Aspergillus	medium thick	none	septate	present	much	very distinct
Botrytis	medium thick	none	septate	present	much	pointed tips
Fusarium	finer	clumps	septate	very distinct	much	pointed tips
Mucor	thickest	none	non-septate	distinct	much	some bulging
Oospora lactis	finer	none	septate	present	unique	pointed tips
Penicillium	finer	clumps	septate	present	short	present
Rhizopus	very thick	none	non-septate	very distinct	much	distinct

TABLE III. PERCENT POSITIVE FIELDS IN MOLD COUNTS

	Percent Positive Fields Replication										
Genus	1	2	3	4	5	6	7	8	9	10	Ave.
Oospora lactis	2	4	2	0	2	0	0	0	2	0	1.2
Penicillium	2	10	12	0	6	0	4	6	6	6	5.2
Fusarium	8	16	6	16	26	10	10	12	10	8	12.2
Alternaria tenuis	16	20	14	12	22	14	14	16	12	14	15.4
Rhizopus	6	14	6	16	26	24	14	16	24	24	17.0
Botrytis	24	30	44	22	10	26	10	20	12	26	22.4
Aspergillus	40	46	48	24	36	34	26	88	36	24	40.2
Mucor	44	60	52	48	42	66	62	46	62	60	54.2

THE INFLUENCE OF PRESERVATION METHODS ON THE COLOR AND OTHER QUALITY ATTRIBUTES OF GREEN BEANS

by

William M. Hildebolt and Wilbur A. Gould

Eleven cultivars were studied with the aim of determining the influence of blanching, canning, freezing, freeze-drying and irradiation on the color and general quality of green beans. The cultivars are given in Table I.

The beans were harvested by hand and all processes were performed in the laboratory using pilot plant equipment. Colorimetric and chemical measurements were made on the raw product and immediately after each blanching treatment and appropriate storage periods. The variables studied within each process were the maturity classification, blanching time and temperature, and storage period.

Color was measured objectively by means of the Hunter Color and Color-Difference Meter and the Agtron M-30. These results were compared to the values obtained from the chlorophyll retention determination in order to establish the relationship which existed between these two methods of color measurement. The color of the processed green beans was also subjectively evaluated according to the U.S.D.A. color standards. The colorimetric measurements which were found to have significance in the color measurement of green beans were used to determine the effect of the horticultural and processing variables on the color of the processed product. The results of this study are summarized as follows:

1. The results of the colorimetric analysis indicated that both reflectance photoelectric colorimeters were only slightly significant in the prediction of the chlorophyll retentions.

2. The Agtron R mode was found to be the most significant of all the reflectance values when compared to the U.S.D.A. color scores. The Hunter a/b ratio was also found to be highly significant. The regression equations derived from the colorimetric values correlated very highly with the results obtained from the subjective color analysis. These regression equations were found capable of predicting very accurately the color grade of processed green beans. It was also found that a two-dimensional plot of the Hunter a and b values gave good separation in the designation of the A, B, and C grades for frozen green beans.

3. The horticultural variables of cultivar and maturity were found the most influential of all the variables studied. The 1-3 sieve size (whole) maturity classification retained the most chlorophyll and was of better color than the 4-6 sieve size (cut) for all processes studied. Cultivars Green Pod 488 and Green Pod 64-478 were determined to be the best according to color and overall quality.

4. Both the blanching and brining techniques were shown to have little or no affect on the color of stored canned green beans. The blanching method did, however, greatly influence the degree of epidermal sloughing found in the canned product. Severe sloughing was induced by steam blanching. Since the color of canned green beans was not protected after extended storage by any combination of processing variables, the results of this study indicated that the best procedure for the production of consistently high quality product would be to use techniques which reduce the tendency of the beans to slough.

5. It was observed in the frozen product that the buffered blanching methods helped to protect the color of the beans better than the reference steam and water blanches. Similar results were found for the freeze-dried product. A consistently high quality product was obtained from both processes.

6. The results of the analysis of the irradiated product indicated that the color was very much similar to that of a cooked product. In general, the overall quality of the irradiated product was poor, but if more control could have been exercised over the dosage level received by the green beans, a much higher quality product would have probably resulted.

7. The results of the pH, total acid, and Vitamin C analysis indicated that each processing variable influenced the chemistry of the green beans. The pH and the percent total acid was found to vary slightly from one process to another and there was no relationship between the inherent acidity and the chlorophyll retention of the green beans. The Vitamin C content was decreased by approximately one-half during the canning process. Little change was noted in the ascorbic acid content of the raw product and that of either the frozen or freeze-dried product.

REFERENCE

Hildebolt, William M., "The Influence of Preservation Methods on the Color and Other Quality Attributes of Green Beans (*Phaseolus Vulgaris* L.)." Unpublished Ph.D. Dissertation, The Ohio State University (1969).

TABLE I. SNAP BEAN CULTIVARS

Code	Cultivar	Lot No.*
1.	Tempo	206
2.	Green Pod	63-321
3.	Green Pod	64-489
4.	Green Pod	488
5.	Green Pod	64-478
6.	Dark Earligreen	66-312
7.	Green Pod Tendercrop	64
8.	Astro	26271
9.	Tendercrop	83
10.	Sparton Arrow	76
11.	Tenderette	81

*The seed was supplied by Rogers Brothers Company, Idaho Falls, Idaho.

EVALUATION OF VARIOUS GRAPE CULTIVARS FOR PROCESSING IV. TABLE WINES

by

J. F. Gallander

During the 1968 season, twenty-two grape cultivars were processed and evaluated for their table wine quality. The cultivars used in this study were grown at the Southern Branch of the Ohio Agricultural Research and Development Center in Ripley, Ohio. Each cultivar was harvested at maturity and transported to the Department of Horticulture in Wooster, Ohio, for processing.

Before the fermentation was initiated, a representative sample of each received grape cultivar was analyzed for the following:

1. pH. The pH was determined by the glass electrode method (Beckman Zeromatic pH meter) using 10 ml. of grape juice diluted with 90 ml. of distilled water.

2. Total Acids. A 10 ml. grape juice sample was titrated with a 0.1 normal sodium hydroxide solution to a pH of 8.2. The percent total acids was calculated as tartaric.

3. Total Soluble Solids. The soluble solids content was determined by using an Abbe refractometer.

4. Total Sugars. The total sugar content of the grapes was determined by the Lane and Eynon procedure and was expressed as reducing sugars.

The results of the chemical analyses for each grape cultivar are shown in Table I. The pH of the raw juice samples varied between 3.15 (Blue Eye) and 3.60 (Van Buren and Couderc 17). Baco #1 was highest in total acids with 1.36 percent and Van Buren lowest with 0.60 percent. The percent soluble solids, an indication of the sugar content, varied widely. Baco #1 tested highest (17.6 percent), and Fredonia lowest, (12.8 percent).

After the analysis of the raw product, each grape cultivar was fermented by a standard procedure. The received grapes were stemmed, crushed and treated with 100 ppm SO_2. Then, sugar was added to the crushed grapes to bring the original soluble solids content to 22 percent. After 24 hours, an active yeast culture was added, and the fermenting grapes were stirred twice daily. The fermenting white grapes were pressed 24 hours after yeast inoculation, while the blue and red musts were pressed 4 days after yeast was added. After pressing, the grape must of each cultivar was divided into two lots. One lot was directly transferred to

glass carboys and represented wine with no amelioration (0% amelioration). Before transferring to carboys, the other lot was ameliorated with 22 percent sugar syrup (30% amelioration). All carboys were equipped with "water seals," and the fermentations were completed in approximately 3 weeks. The wines were racked several times over a 3 months period and then bottled.

After one month storage (34°F.), the wines were analyzed for various chemical constituents:

1. Total Acids: The wine was titrated with a 0.1 normal sodium hydroxide solution to a pH of 8.2. The percent total acids was calculated as tartaric.

2. Total Sugars: The total sugar content of the wines was determined by the Lane and Eynon procedure and was expressed as reducing sugars.

3. Alcohol: The alcohol content was determined by using an ebullioscope, Dujardin - Salleron Type.

4. Tannin: The tannin content was determined by using the standard (Pro) procedure.

5. Extract: The extract of the wines was determined by taking the density of a dealcoholized sample.

In general, all wines were low in sugar content and were considered dry. The pH and alcohol content of wines with no amelioration were lower than those wines ameliorated to 30 percent. In contrast, the content of the other constituents was decreased when the wine was ameliorated. The results of the organoleptic evaluation indicated that the ameliorated wines were best and cultivars: Seibel 5279, Seibel 9549, Seibel 10878 and S.V. 12375 were considered superior in overall quality.

TABLE I. COMPOSITION OF VARIOUS GRAPE CULTIVARS, 1968 SEASON

Cultivar	Harvest	Color	pH	Total Acids %	Soluble Solids %	Total Sugars %
Ontario	Aug. 13	White	3.55	0.66	15.8	14.3
Schuyler	Aug. 13	Blue	3.45	0.68	14.5	13.3
Buffalo	Aug. 13	Blue	3.30	0.96	15.3	10.3
Alden	Aug. 20	Blue	3.35	0.84	13.1	11.8
Kendaia	Aug. 20	Blue	3.45	0.70	14.2	11.7
Seibel 5279	Aug. 20	White	3.30	1.02	14.2	12.5
Seibel 9549	Aug. 20	Blue	3.20	1.30	14.0	12.3
Seibel 7053	Aug. 28	Blue	3.30	1.07	15.0	12.6
Seibel 10878	Aug. 28	Blue	3.30	1.06	17.1	15.6
Van Buren	Aug. 28	Blue	3.60	0.60	13.0	9.5
Fredonia	Aug. 28	Blue	3.35	0.76	12.8	9.7
Bath	Sept. 5	Blue	3.35	0.69	14.8	11.9
Steuben	Sept. 5	Blue	3.45	0.62	16.1	11.5
Baco #1	Sept. 5	Blue	3.40	1.36	17.6	15.6
Golden Muscat	Sept. 5	White	3.40	0.93	14.8	13.3
Vidal 256	Sept. 5	White	3.40	0.80	16.7	16.0
Bokay	Sept. 11	White	3.20	1.12	14.9	13.2
Couderc 7120	Sept. 19	Blue	3.20	1.28	14.6	12.6
S.V. 12375	Sept. 24	White	3.20	1.10	13.4	12.5
Blue Eye	Sept. 24	Blue	3.15	1.23	13.6	11.7
Sheridan	Sept. 24	Blue	3.40	0.68	15.4	11.6
Couderc 17	Sept. 24	Blue	3.60	0.61	15.6	13.4

TABLE II. COMPOSITION OF WINES FROM VARIOUS GRAPE CULTIVARS, 1968 SEASON

Cultivar	Amelio-ration	Total Sugars %	pH	Total Acids %	Alcohol %	Extract Gms. Per 100 c.c.	Tannin Mgs. Per 100 c.c.	Sensory Remarks
Ontario	0	0.18	3.60	0.60	13.9	2.12	45	Fine flavor and
	30	0.26	3.60	0.49	14.1	1.91	33	aroma. Labrusca
Schuyler	0	0.27	3.25	0.65	12.9	2.22	60	Fruity, weak aroma
	30	0.14	3.30	0.51	13.5	1.61	41	and flavor.
Buffalo	0	0.25	3.20	0.91	12.6	2.42	104	Mild labrusca, fruity
	30	0.17	3.30	0.69	14.6	1.81	75	and dark red.
Alden	0	0.09	3.40	0.71	13.2	1.91	79	Sharp, muscat and
	30	0.09	3.50	0.54	13.6	1.61	52	poor flavor
Kendaia	0	0.11	3.50	0.61	13.0	2.02	73	Weak aroma and
	30	0.13	3.50	0.49	13.7	1.41	51	flavor.
Seibel 5279	0	0.13	3.45	0.97	13.2	2.42	44	Neutral, good flavor
	30	0.28	3.45	0.75	13.8	2.01	32	and aroma.
Seibel 9549	0	0.16	3.20	0.89	12.8	2.32	71	Excellent flavor and
	30	0.25	3.30	0.67	13.4	1.92	50	aroma. Good body.
Seibel 7053	0	0.22	3.40	0.81	12.4	2.22	72	Neutral, good aroma
	30	0.16	3.45	0.65	13.1	2.01	56	and body.
Seibel 10878	0	0.21	3.30	0.92	12.3	2.52	84	Good aroma and
	30	0.25	3.35	0.70	13.1	2.11	62	flavor.

TABLE II. (Continued)

Cultivar	Amelio-ration	Total Sugars %	pH	Total Acids %	Alcohol %	Extract Gms. Per 100 c.c.	Tannin Mgs. Per 100 c.c.	Sensory Remarks
Van Buren	0	0.14	3.55	0.51	12.7	2.21	88	Labrusca, dark red
	30	0.11	3.60	0.47	13.6	1.41	64	and fruity.
Fredonia	0	0.09	3.25	0.80	12.7	2.22	58	Strong labrusca, dark
	30	0.16	3.35	0.64	13.3	1.91	45	red color.
Bath	0	0.20	3.30	0.71	13.0	2.83	67	Pleasant labrusca,
	30	0.91	3.35	0.51	13.6	2.21	52	fruity; light red.
Steuben	0	0.09	3.40	0.67	13.0	1.91	76	Fruity, light red
	30	0.16	3.45	0.56	13.5	1.71	64	color, fair.
Baco #1	0	0.10	3.50	0.97	11.4	2.92	81	Fair aroma and
	30	0.17	3.50	0.74	13.0	2.02	71	flavor, astringent.
Golden Muscat	0	0.14	3.40	0.80	14.0	2.01	27	Acid, fair
	30	0.23	3.45	0.68	14.1	1.81	23	muscat.
Vidal 256	0	0.09	3.60	0.72	14.0	2.32	47	Fine aroma, tart
	30	0.14	3.65	0.61	14.2	1.92	42	and harsh.
Bokay	0	0.20	3.25	0.97	13.2	2.42	26	Neutral, acid
	30	0.29	3.30	0.75	13.8	2.21	20	and fair.
Couderc 7120	0	0.15	3.20	1.01	13.0	2.32	64	Fair aroma and flavor;
	30	0.17	3.30	0.76	13.6	1.72	43	good color.

TABLE II. (Continued)

Cultivar	Amelio-ration	Total Sugars %	pH	Total Acids %	Alcohol %	Extract Gms. Per 100 c.c	Tannin Mgs. Per 100 c.c	Sensory Remarks
S.V. 12375	0	0.26	3.40	0.76	14.0	2.32	31	Good aroma, pleasant
	30	0.42	3.45	0.62	14.2	2.01	27	flavor, excellent.
Blue Eye	0	0.16	3.25	1.06	13.9	2.32	60	Weak aroma, tart
	30	0.57	3.30	0.80	14.0	2.02	46	and thin body.
Sheridan	0	0.21	3.30	0.89	13.4	2.32	79	Flowery aroma, light
	30	0.15	3.40	0.68	13.6	2.11	58	red color, fair.
Couderc 17	0	0.15	3.60	0.51	13.4	2.21	45	Weak flavor and
	30	0.11	3.60	0.47	13.8	1.81	35	aroma.

THE EFFECT OF GRAPE MUST PRESSING TREATMENTS ON SOME FACTORS OF IMPORTANCE TO THE STIMULATION OF INDUCED MALO-LACTIC FERMENTATION

by

Robert B. Beelman, James F. Gallander and Wilbur A. Gould

INTRODUCTION

Malo-lactic fermentation is a bacterial conversion of the inherent malic acid of a wine to lactic acid and carbon dioxide by the metabolic action of certain strains of lactic acid bacteria. The primary effects of this fermentation are a natural deacidification of the wine as well as the addition of some bacterial metabolic products that apparently contribute to the wine flavor.

The importance of malo-lactic fermentation as a natural means of deacidification in the wine making process has been reported extensively. It has been proposed to be extremely important in climatic areas with short growing seasons and subsequently high acid grape musts.

In a previous study in this laboratory, it was found that malo-lactic fermentation could be successfully induced in a high acid Ohio grape must by inoculation with selected strains of malo-lactic bacteria and the use of appropriate vinification procedures. It should be noted that in this study fermentation was carried out "on the skins" for a period of five days before pressing--a standard procedure in the production of most red table wines. However, in later studies, attempts to induce malo-lactic fermentation in hot and cold pressed grape musts were unsuccessful. Since many of the wine makers in the Eastern United States utilize hot and cold pressed grape musts for table wine production, this presents a serious problem if induced malo-lactic fermentations are to be attempted on a commercial scale.

Therefore, it was the purpose of this investigation to study the effect of various grape must processing treatments on some factors of importance to the stimulation of induced malo-lactic fermentation.

MATERIALS AND METHODS

In Experiment I of this study grape musts were prepared by hot pressing (crushed grapes heated to 145°F. and pressed); cold pressing (crushed grapes pressed at ambient temperature); and by fermentation "on the skins" for 1, 3, and 5 days before pressing. All musts were inoculated with malo-lactic bacterium, Leuconostoc

citrovorum (ML 34) (except control lots which received no bacterial inoculation). All the musts were otherwise treated by standard vinification procedures used in this laboratory as follows: sugar adjusted to 22 degrees Brix with sucrose, inoculated with Montrachet #522 yeast strain, treated with 50 ppm SO_2, and racked five weeks after the yeast inoculation.

The occurrence and rate of malo-lactic fermentation was determined by paper chromatographical analysis of the organic acids of the wines at regular intervals during the fermentation. Counts of the viable malo-lactic bacteria were made at regular intervals during the fermentation in all the wines by a pour-plate technique. Analysis of pH, total acidity, and L-malic acid content of the fresh grape musts and finished wine were made by standard procedures of this laboratory. Procedures were developed for the isolation and determination of the protein content and the content of two non protein-nitrogen (NPN) fractions from the musts and wines. Analyses of these fractions were conducted at regular intervals during the fermentation analyses of the free amino acids of the different musts at three selected times during the fermentation were conducted using an automatic amino acid analyzer.

In Experiment II of this investigation, model grape musts were prepared that simulated the grape musts prepared in Experiment I, but allowed evaluation of the chemical nature of the different musts independent of chemical changes caused by yeast and bacterial metabolism. Chemical evaluation of these model musts were conducted as described above. In addition, isolates were prepared from these model musts that were assayed by two microbiological assays developed to determine the presence of growth factor(s) stimulatory to the growth of the malo-lactic bacterium, Leuconostoc citrovorum (ML 34) and the ability of this organism to ferment malic acid.

RESULTS AND DISCUSSION

Experiment I of this investigation indicated that fermentation on the skins before pressing (in contrast to hot or cold pressing) had a profound effect on the occurrence and rate of induced malo-lactic fermentation. This study demonstrated that the grape musts prepared by cold and hot pressing as well as by fermentation on the skins for 1 day before pressing supported only limited growth of the inoculated malo-lactic bacteria and no malo-lactic fermentation was detected in these treatments (see Figure 1 and Table I). On the other hand, the must treatments that were fermented on the skins for 3 days before pressing underwent a delayed but incomplete malo-lactic fermentation in which approximately half of the malic acid was fermented. The musts that were fermented 5 days on the skins before pressing were observed to undergo malo-lactic fermentation that was completed by 11.3 weeks after the initial bacterial inoculation.

Chemical evaluation indicated that the different treatments employed in this experiment affected the pH of the resultant grape musts which may have affected the susceptability of the musts to induced malo-lactic fermentation (see Table II). However, no definite relationship was observed between the pH, total acidity or L-malic acid content of the different must treatments and the occurrence or rate of malo-lactic fermentation. Evaluation of the nitrogenous substances of the different grape must treatments indicated that no relationship existed between the protein content, the content of two different non protein-nitrogen (NPN) fractions, or the concentration of 17 different free amino acids on the occurrence or rate of malo-lactic fermentation. In addition, evaluation of these nitrogenous substances at regular intervals during the fermentation indicated that the malo-lactic bacteria did not utilize significant amounts of the protein or the substances in NPN Fraction #2 in any of the must treatments. On the other hand, the results did indicate that malo-lactic bacteria apparently utilized a significant amount of the nitrogenous substances in the NPN Fraction #1 in the must treatment which underwent malo-lactic fermentation (see Figure 2). Paper chromatographical analysis of the NPN Fraction #1 indicated that it contained peptides that were used by the actively growing bacteria, apparently as a readily available source of amino nitrogen. However, additional evidence indicated that these peptides evidently did not act as growth factors and were not the prime factor in determining stimulation of malo-lactic fermentation. Analyses of the free amino acids indicated that several of the 17 amino acids quantitatively analyzed were utilized by the malo-lactic bacteria in amounts relative to the bacterial growth observed in the different musts. The amino acids that were utilized by the bacteria were arginine, threonine, serine, proline, alanine, valine, leucine, and phenylalanine.

Chemical evaluation of the model grape musts of Experiment II (see Table III) indicated that the different treatments did affect the pH of the resultant musts. Results demonstrated that the musts simulating fermentation on the skins had higher pH values than the musts simulating cold and hot pressed musts. A correlation was observed between the pH of the model musts and the amount of malo-lactic bacterial activity observed in the corresponding must treatments of Experiment I. However, evaluation of the nitrogenous substances as was accomplished in Experiment I indicated that the different must treatments did not appear to have any significant effect on any of these fractions. In addition, no trend was observed concerning the content of any of these fractions and the occurance or rate of malo-lactic fermentation observed in the corresponding must treatments of Experiment I.

Isolates prepared from the model grape musts were demonstrated to contain substance(s) that were stimulatory to the growth of the malo-lactic bacterium, Leuconostoc citrovorum (ML 34). Microbiological assays of the isolates indicated that a direct relationship existed

between the growth response the different isolates caused and the amount of malo-lactic bacterial growth that occurred in the corresponding must treatments of Experiment I (see Figure 3). Bioautographical examination of paper chromatograms of the isolates indicated that the active substance(s) in the model musts may have been the same as a new growth factor recently discovered in tomato juice and other fruits such as grapes.

CONCLUSIONS

Based on the results observed in this investigation the following conclusions were made concerning stimulation of induced malo-lactic fermentation in grape musts prepared by hot and cold pressing and by fermentation on the skins:

1. Fermentation on the skins (compared to hot or cold pressing) has a profound stimulatory effect on stimulation of induced malo-lactic fermentation. Therefore, fermentation on the skins for a period of 5 days before pressing is recommended as the proper means of color extraction in red table wine production when an induced malo-lactic fermentation is desired.

2. The stimulatory effect of fermentation on the skins might be in part due to an increase in pH that results from this process relative to hot or cold pressing. However, the results indicated that other factors, in addition to pH, are important in stimulatory malo-lactic fermentation.

3. The stimulatory effect of fermentation on the skins (relative to hot and cold pressing) might be in part due to the increased extraction of a new growth factor from the grapes caused by fermentation on the skins.

4. The stimulatory effect of fermentation on the skins was not apparently due to differences in the content of various nitrogenous fractions that were analyzed in this study.

REFERENCE

Beelman, Robert B., "The Effect of Grape Must Pressing Treatments on Some Factors of Importance to the Stimulation of Induced Malo-Lactic Fermentation." Unpublished Ph.D. Dissertation, The Ohio State University (1970).

TABLE I. DETECTION OF MALO-LACTIC FERMENTATION IN THE MUSTS OF EXPERIMENT I.

Treatment	Malo-Lactic Fermentation Completed Before (weeks)
Cold Pressed	a
Hot Pressed	a
Fermented on Skins (1 day)	a
Fermented on Skins (3 days)	b
Fermented on Skins (5 days)	11.3[c]

a No malo-lactic fermentation observed after one year
b Malo-lactic fermentation initiated after 10 weeks but not completed after one year
c Uninoculated control of this treatment completed malo-lactic fermentation at 36 weeks

TABLE II. GENERAL CHEMICAL ANALYSIS OF THE GRAPE MUSTS OF EXPERIMENT I - 5 DAYS AFTER THE INITIATION OF FERMENTATION

Treatment	pH	Total Acidity (g/100 ml as tartrate)	L-Malic Acid (g/100 ml)
Cold Press	3.21	1.58	0.92
Hot Press	3.33	1.70	1.02
Fermented on Skins (1 day)	3.34	1.41	0.92
Fermented on Skins (3 days)	3.33	1.45	0.90
Fermented on Skins (5 days)	3.40	1.36	0.92

TABLE III. GENERAL CHEMICAL ANALYSIS OF MODEL GRAPE MUSTS OF EXPERIMENT II.

Must Treatment	pH	Total Acidity (g/100 ml as tartrate)	Soluble Solids (°Brix)	L-Malic Acid (g/100 ml)
4% Alcohol Extract	3.40	1.05	16.0	0.77
8% Alcohol Extract	3.43	1.03	16.8	0.78
12% Alcohol Extract	3.49	1.04	17.8	0.78
Cold Press	3.27	1.14	19.0	0.71
Hot Press	3.30	1.24	20.6	0.75

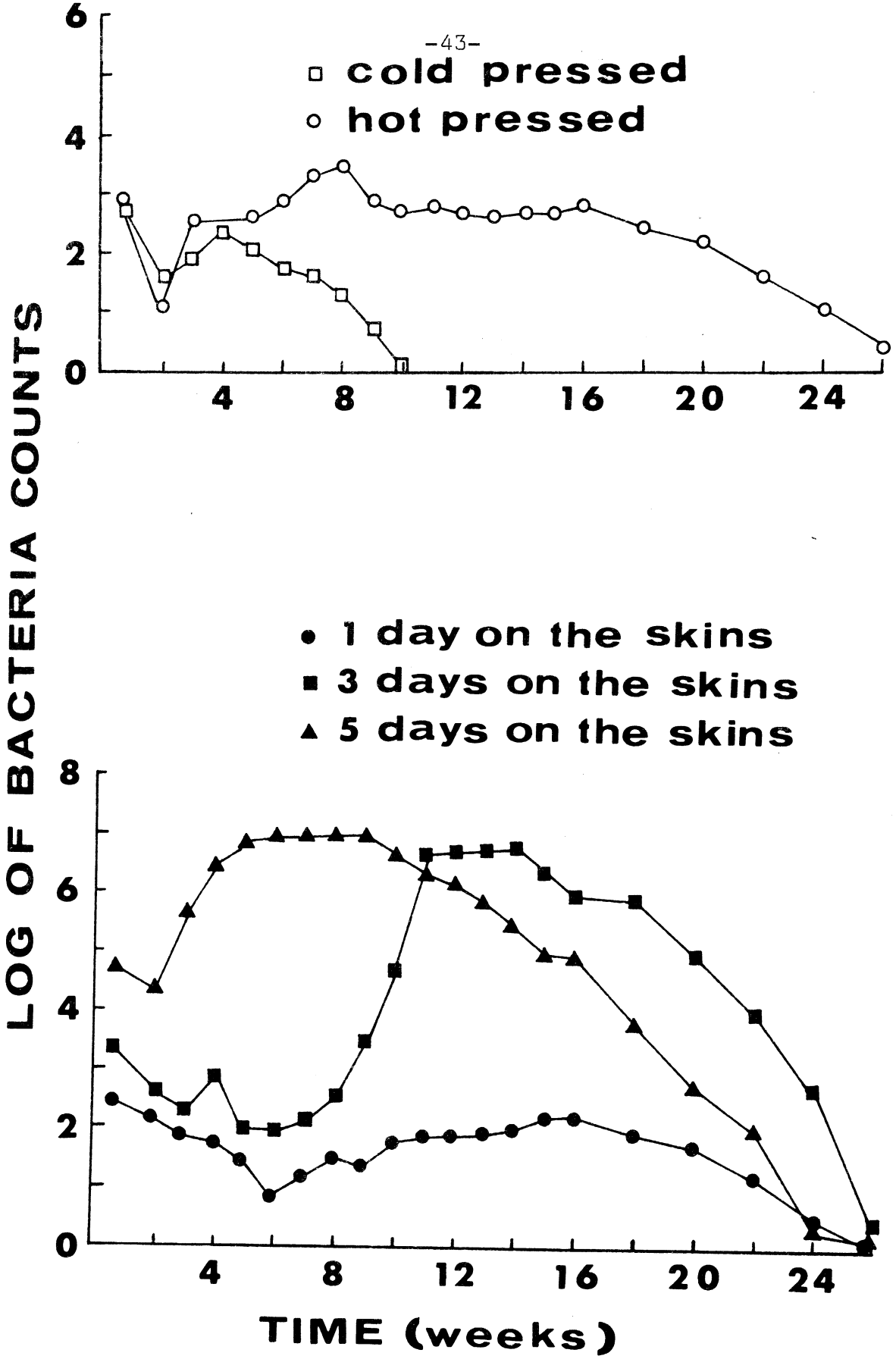

Figure 1. Growth curves of the malo-lactic bacteria in the different grape must treatments illustrated as the log of viable bacteria counts (organisms/ml) as a function of time after the initial bacterial inoculation.

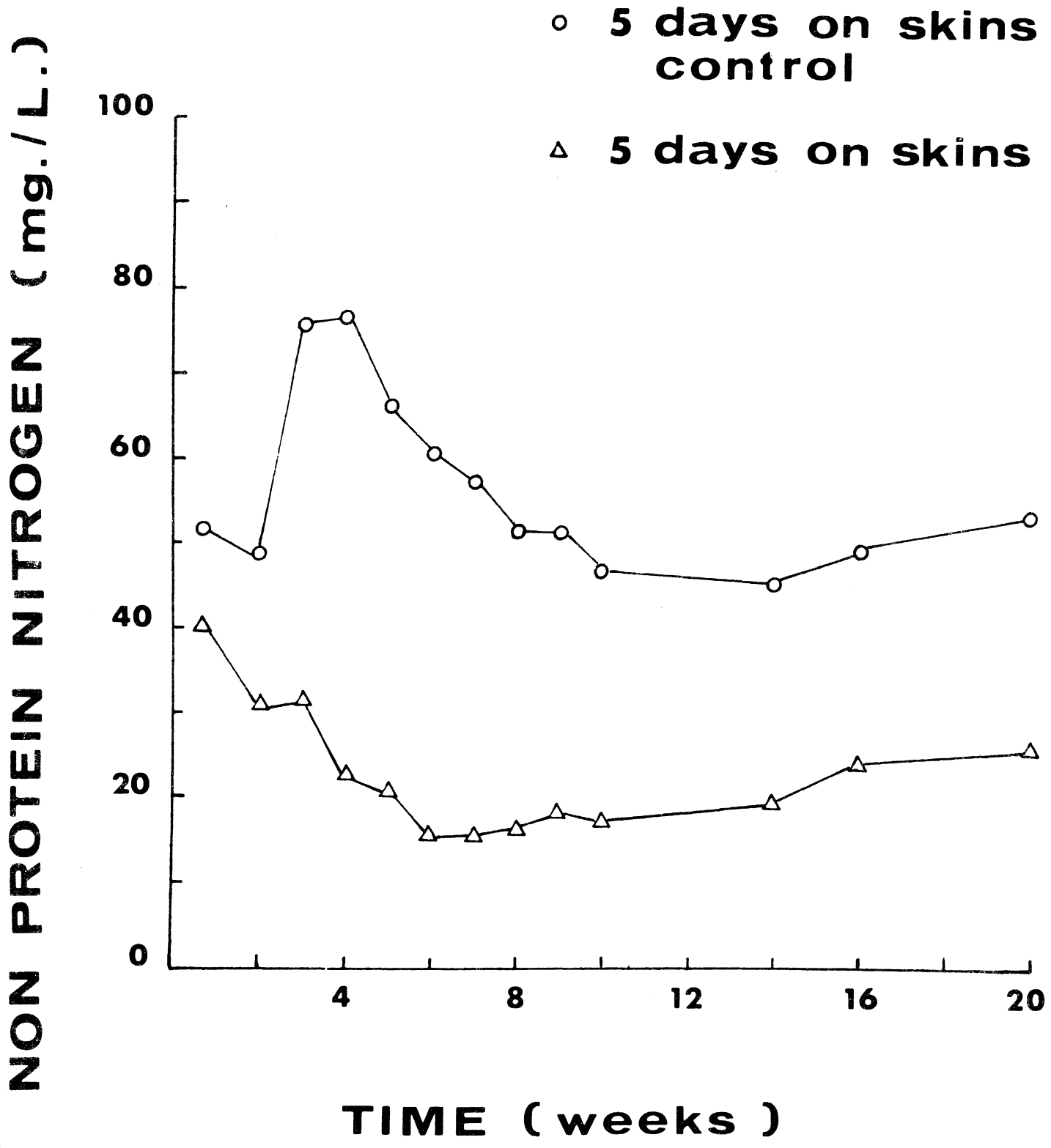

Figure 2. The non protein nitrogen of Fraction #1 isolation from the grape musts fermented 5 days on the skins as a function of time after the yeast and initial bacterial inoculation.

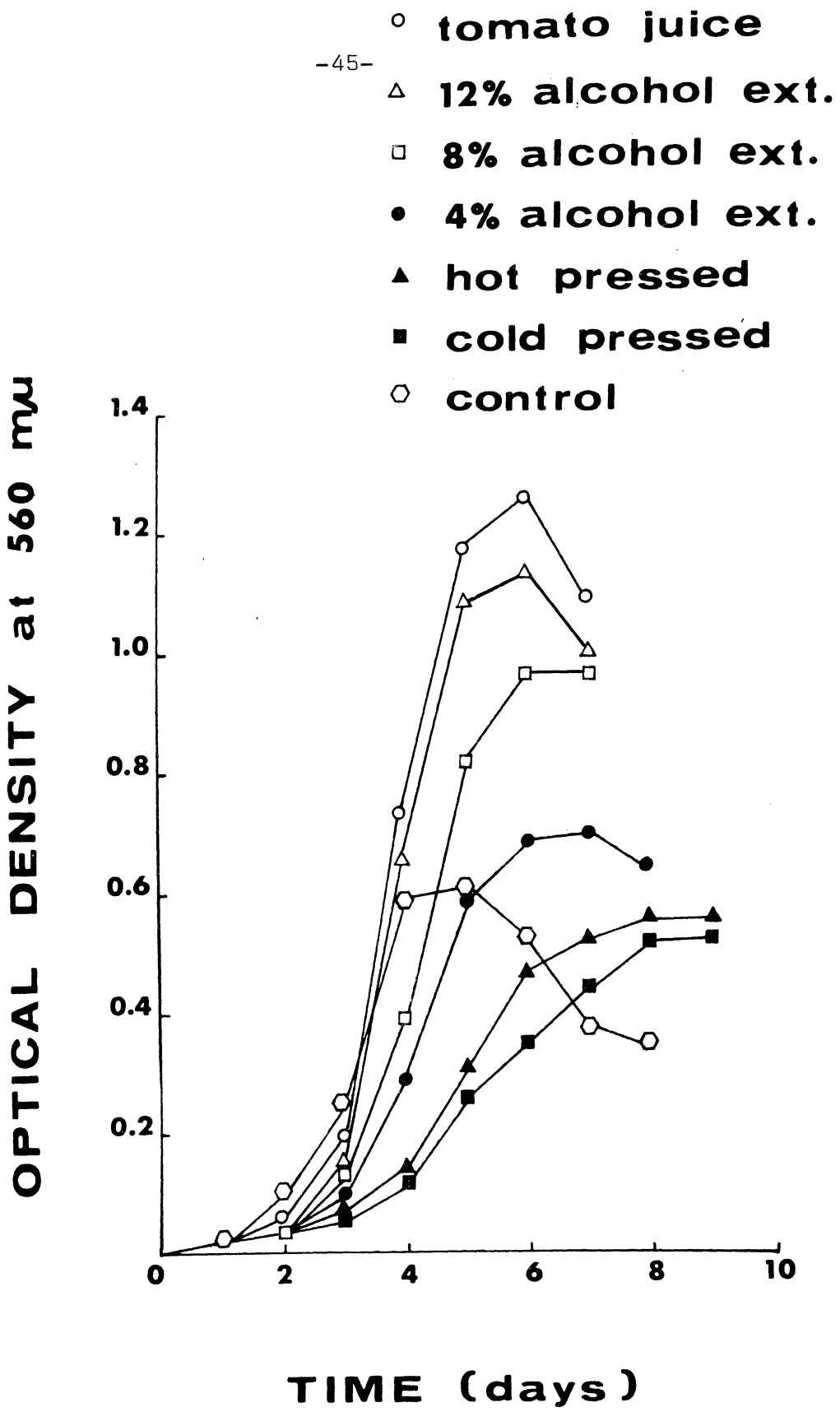

Figure 3. Microbiological assays of the growth factor isolates from the model grape musts of Experiment II and tomato juice in a concentration of 4.0 percent(v/v) by the turbidity-tube method.

ANALYSIS OF QUALITY FACTORS IN MEAL COMPONENTS PROCESSED BY FREEZING

by

Marion Cremer and Wilbur A. Gould

INTRODUCTION

Increased productivity through utilization of processing technology may facilitate solution of labor problems in the service segment of the food industry. This may involve time and place separation of food production from food service and demand some form of food preservation. Factors affecting acceptability of food may be highly important. The objective of this study was to analyze the acceptability of selected meal components processed by freezing and to examine the effect of certain variations.

Horticultural components studied were mashed potatoes and peas. Variations incorporated were quality of ingredient and portion size. One-half and three-quarter cup portion sizes of both New Jersey white (probably Katahdin) and Washington Russet potatoes were utilized. Portion size was the only variation in peas. Three-quarter and one-half cup portion sizes were used.

PROCEDURE

Mashed potato preparation was based on a standardized formula (Fowler). Peas, previously processed by freezing, were not thawed but included directly along with seasoning ingredients. Food was packaged in shallow aluminum containers, covered with heavy aluminum foil, and frozen at (-5°F.). Food to be readied for service was taken directly from the freezer and placed in a stack-type oven set at (550°F.). Heating time was 20 minutes.

Acceptability was determined by a ten-member taste panel consisting of college age students studying in the area of food technology. Each of the meal components was scored for six factors of quality by means of a ten-point descriptive scale. Ten was described as perfect; nine, eight, and seven, good; six, five, and four, fair; three and two poor; and one, unacceptable.

Factors scored for potatoes were appearance, color, flavor, texture, portion size, and general acceptability. Factors scored for peas were appearance, color, flavor, tenderness, portion size, and general acceptability. Data were analyzed statistically by means of the Analysis of Variance and Duncan's New Multiple Range Test.

RESULTS AND DISCUSSION

Peas

Acceptability of peas as a component of a complete meal processed by freezing was rather high. This is indicated by average scores presented in Table I. All of these scores were above eight and well within the "good" range according to the ten-point descriptive scale used for evaluation.

TABLE I. MEAN SCORES FOR QUALITY FACTORS IN PEAS

	Variation	
Factor	1/2 cup	3/4 cup
Appearance	9.0	8.8
Color	8.8	8.4
Flavor	8.9	8.6
Tenderness	8.4	8.1
Portion Size	8.6	9.2**[a]
General Acceptability	9.0	8.7

[a]Symbol (**) indicates higher score significant at .01 level for factor and variation.

Variation in peas as a component of the frozen complete meal was with regard to portion size only. Thus, any differences in scores among samples might be expected to result from the effect of heating or cooking the larger size portion the same period of time as the smaller.

Significant differences in scores are indicated in Table I. Portion size was the only factor for which the variation made a significant (.01) difference. Preference was for the larger portion. The one-half cup portion was scored slightly higher than the three-quarter cup portion for all of the other factors.

Potatoes

Two cultivars and two portion sizes of mashed potatoes processed by freezing were found to be highly acceptable. Mean scores and significant differences are shown in Table II. All averages are above seven and within the "good" range of acceptability as based on the ten-point scale used.

Certain facts may be of particular interest with regard to variations and quality factors scored for potatoes. The larger size portion was scored significantly (.01) higher than the smaller. Moreover, the variation in portion size significantly affected scores for all quality factors considered. These included appearance, color, texture, flavor, and general acceptability. This may be due to individual predisposition to think more favorably in terms of the larger amount of food. However, possibly the Browning reaction occurred to a greater extent during reconstitution of the smaller portion.

TABLE II. MEAN SCORES FOR QUALITY FACTORS IN POTATOES

	Variation			
	Type		Portion Size	
Factor	Washington Russet	New Jersey (white)	1/2 cup	3/4 cup
Appearance	8.2	8.3	7.4	9.0**[b]
Color	8.5	8.4	8.1	8.8**
Flavor	8.2	8.2	7.8	8.6*
Texture	8.3*[a]	7.9	7.9	8.3*
Portion Size	8.4	8.3	7.7	9.0**
General Acceptability	8.3	8.3	7.9	8.7**

[a]Symbol (*) indicates higher score significant at .05 level for factor and variation.

[b]Symbol (**) indicates higher score significant at .01 level for factor and variation.

Texture was the only factor significantly (.05) affected by variation in type of potato. As can be seen in Table II, Washington Russet was the higher scoring type. This does not mean that quality of ingredient had no effect on acceptability. Perhaps both types of potatoes were of high quality. This may be indicated by the fact that average scores for all factors were well above seven which places all samples within the "good" range of acceptability.

Three-way Analysis of Variance and grouping of means according to Duncan's New Multiple Range test revealed differences which might be of some interest. General acceptability, portion size,

and appearance of peas were scored significantly (.05) higher than were the same factors in potatoes.

Higher scores for peas than potatoes may indicate the importance of the green vegetable portion of the complete meal. These higher scores for peas may also mean that a superior method of preparation is to incorporate uncooked or partially cooked food which is cooked at the time of reconstitution.

Relatively lower scores for quality in potatoes may indicate need for further work with this component. Consideration might be given to portion size in relation to variations in temperature and kinds of equipment used for reconstitution. Variations in solids content of potatoes, whipping time, and proportion of added milk might also be considered in relation to various methods for reconstitution.

REFERENCES

Cremer, Marion, "Analysis of Quality Factors in Meal Components Processed by Freezing." Unpublished Ph.D. Dissertation, The Ohio State University (1969).

Fowler, Sina Faye, Bessie Brooks West, and Grace Severance Shugart, Food for Fifty. Fourth edition. New York: John Wiley and Sons, Inc., (1969).

This page intentionally blank.

This page intentionally blank.

This page intentionally blank.